IN THE CLAIMS

1-8.   (Cancelled)

9.   (Original) A method of evaluating a process chamber, comprising:

performing a first substrate processing operation and a first process perturbation operation in a reference chamber;

collecting optical emission spectroscopy (OES) data and radio frequency (RF) data during the first substrate processing operation and the first process perturbation operation;

performing a first multivariate analysis on the collected OES and RF data from the reference chamber to produce first multivariate analysis results;

performing a second substrate processing operation and a second process perturbation operation in a process chamber that is under study, where the first process operation and the second process operation are similar, and the first process perturbation operation and the second process perturbation operation are similar;

collecting OES data and RF data during the second process operation and the second process perturbation operation;

performing a second multivariate analysis on the collected OES and RF data from the chamber under study to produce second multivariate analysis results; and

comparing the second multivariate analysis results from the chamber under study to the first multivariate analysis results from the reference chamber.

10.   (Previously Presented) The method of claim 9 further comprising using a result of comparing the second multivariate analysis results to the first multivariate analysis results to calibrate the chamber under study.

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11.   (Previously Presented) The method of claim 9, further comprising:

using a result of comparing the second multivariate analysis results to the first multivariate analysis results to identify a fault in the chamber under study.

12.   (Currently Amended) The method of claim 9, wherein the first and second multivariate analyses comprise ~~principle~~ principal component analysis (PCA).

13.   (Currently Amended) The method of claim 9, further comprising:

determining if the OES and/or RF data collected from the reference chamber need to be manipulated;

performing ~~the~~ data manipulation on the data collected from the reference chamber;

performing a multivariate analysis on the revised OES and RF data from the reference chamber; and

manipulating the OES and/or RF data collected from the process chamber that is under study according to the data manipulation scheme developed for the reference chamber.

14.   (Currently Amended) The method of claim 13, wherein steady ~~principle~~ principal components and transitional ~~principle~~ principal components are identified for the reference chamber and the chamber under study by ~~principle~~ principal component analysis.

15.   (Currently Amended) The method of claim 13, wherein comparing the results from the first and second multivariate analyses further comprises performing an inner product of the identified ~~principle~~ principal components for the reference chamber and the chamber under study to generate matching scores.

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16.   (Currently Amended) The method of claim 13, further comprising:

using decomposition of OES and RF data matrixes to yield scores for ~~principle~~ principal components to determine if the OES and/or RF data need to be manipulated.

17.   (Previously Presented) The method of claim 13, further comprising:

enhancing weak signals either by amplifying post perturbation signals, or by selecting a narrower and more sensitive wavelength range or frequency range.

18.   (Original) The method of claim 9, further comprising:

comparing the matching scores to a pre-established matching control limit.

19.   (Currently Amended) The method of claim 9, wherein ~~the~~ an amount of process parameter perturbation is less than 50%.

20.   (Original) The method of claim 9, wherein the process chamber is an etching chamber.

21.   (Original) The method of claim 9, wherein the process chamber is a deposition chamber.

22.   (Currently Amended) The method of ~~claim 9~~ claim 11, further comprising:

accessing a library of stored diagnosis information; and

searching the diagnosis information to determine a solution to repair the identified fault.

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39.   (Previously Presented)   A method of evaluating a process chamber, comprising:

performing a first substrate processing operation, followed by a first process perturbation operation of the first substrate process operation in a reference process chamber;

collecting data of one or more plasma attributes during the substrate processing operation and the following first process perturbation operation in the reference process chamber;

determining if the collected data of plasma attributes of the first process operation and the first process perturbation operation in the reference process chamber need to be manipulated;

performing data manipulation on the data of plasma attributes of the reference chamber that are identified to need data manipulation;

performing a multivariate analysis on the revised data of plasma attributes of the reference process chamber to produce first multivariate analysis results;

performing a second substrate processing operation, followed by a second process perturbation operation of the first substrate process operation in a process chamber that is under study, wherein the first process operation and the second process operation are similar, and the first process perturbation operation and the second process perturbation operation are similar;

collecting data of one or more plasma attributes during the second substrate processing operation and the following second process perturbation operation in the process chamber that is under study;

performing data manipulation on the data of plasma attributes of the process chamber under study according to the data manipulation scheme used by the reference chamber;

performing a multivariate analysis on the revised data of plasma attributes of the process chamber under study to produce second multivariate analysis results;

comparing the second multivariate analysis results from the chamber under study to the first multivariate analysis results from the reference chamber.

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40.   (Previously Presented) The method of claim 39, wherein the one or more plasma attributes are selected from the group consisting of optical electromagnetic emission, RF power, wafer reflectance, process pressure, process temperature, and the combinations thereof.

41.   (Previously Presented) The method of claim 39, wherein the one or more plasma attributes are optical electromagnetic emission, RF power, and wafer reflectance.

42.   (Previously Presented) The method of claim 39, wherein the plasma attribute is wafer reflectance.

43.   (Previously Presented) The method of claim 39 further comprising using a result of comparing the second multivariate analysis results to the first multivariate analysis results to calibrate the chamber under study.

44.   (Previously Presented) The method of claim 39, further comprising:
        using a result of comparing the second multivariate analysis results to the first multivariate analysis results to identify a fault in the chamber under study.

45.   (Currently Amended) The method of claim 39, wherein the first and second multivariate analyses comprise ~~principle~~ principal component analysis (PCA).

46.   (Currently Amended) The method of claim 45, wherein steady ~~principle~~ principal components and transitional ~~principle~~ principal components are identified for the reference chamber and the chamber under study by ~~principle~~ principal component analysis.

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47.   (Currently Amended) The method of claim 39, wherein comparing the results from the first and second multivariate analyses further comprises performing an inner product of the identified ~~principle~~ principal components for the reference chamber and the chamber under study to generate matching scores.

48.   (Currently Amended) The method of claim 39, wherein determining if the collected data of plasma attributes need to be manipulated further comprising:

using decomposition of plasma attributes data matrixes for the reference chamber to yield scores for ~~principle~~ principal components to determine if the data of plasma attributes of the reference chamber need to be manipulated.

49.   (Currently Amended) The method of claim 39, wherein the performing data manipulation further comprising:

enhancing ~~the~~ weak signals either by amplification, or by selecting a narrower and more sensitive wavelength range or frequency range.

50.   (Previously Presented) The method of claim 47, further comprising:

comparing the matching scores to a pre-established matching control limit.

51.   (Currently Amended) The method of claim 39, wherein the first and second process perturbations are performed by varying at least one ~~of the values of the~~ process parameters.

52.   (Currently Amended) The method of claim 51, wherein the ~~amount of~~ at least one process parameter ~~variation~~ is varied by an amount less than 50% of the un-perturbed process parameter.

53.   (Previously Presented) The method of claim 39, wherein the process chamber is an etching chamber.

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54.   (Previously Presented)   The method of claim 39, wherein the process chamber is a deposition chamber.

55.   (Previously Presented)   The method of claim 44, further comprising:

accessing a library of stored diagnosis information; and

searching the diagnosis information to determine a solution to repair the identified fault.

56-61.   (Cancelled)

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